EXPERIMENTAL SIMULATION OF THE GOD EXPERIENCE:
IMPLICATIONS FOR RELIGIOUS BELIEFS AND THE FUTURE OF THE HUMAN SPECIES

by Michael A. Persinger

The application of weak, complex magnetic fields through the cerebral hemispheres elicits experiences of a "sensed presence or "Sentient Being" in normal people. We have hypothesized these experiences are the awareness of the right hemispheric equivalent of the left hemispheric sense of self and may be the prototype for the god experience. Experimental results and clinical measurements have supported this contention. Challenge of religious beliefs, which display many of the characteristics of delusions, may be prevented by the natural characteristics of neurocognitive functions. Because the structures and patterns of activity involved with the god experience may also be associated with aggression, the observation that about 50% of males who have had a religious experience, attend church regularly, and display elevated frequencies of temporal lobe signs would kill in god's name may have profound implications for the future of our species.

INTRODUCTION

One of the fundamental principles of behavioral neuroscience is that all experiences are generated by or correlated with brain activity. This activity is determined by the microstructures within the brain and the patterns of electromagnetic and chemical activity within and between these structures. Structure dictates function and microstructure dictates microfunction.

There are several important extensions of these principles. The first is that all experiences are responses that must be evoked by physical events or stimuli. However the events that function as stimuli are only an extremely small subset of the myriad of events within the environment. Different information within the brain emerges from the varied organization of these experiences.

The principles indicate that all experiences, from the awareness of the sense of self, to the feelings of love, to the presence of God, emerge from brain activity. If the scientist can isolate the controlling stimuli that evoke an experience, then any experience, including the experience of God, should be subject to experimental verification and reproduction within the laboratory.

In 1983 during a routine electroencephalographic (EEG) study to monitor the effects of transcendental meditation, an experienced instructor of that technique displayed an electrical anomaly over her right temporal lobe. During this "electrical seizure," she reported she was "filled with the spirit" and she felt the presence of God with her in the laboratory. The duration of this electrical transient was about 20 sec (Figure 91).

The obvious question emerged. If one could extract from the brain the essential electromagnetic structure with which the experience of God is correlated and then re-apply

this pattern to the person's brain without their knowledge, would that person experience God? Although clinical records of individuals who were diagnosed as complex partial epileptics with a focus within the right limbic or temporal lobe abounded with references to mystical and god experiences, the technology at that time was not available to design an experiment to test that hypothesis.

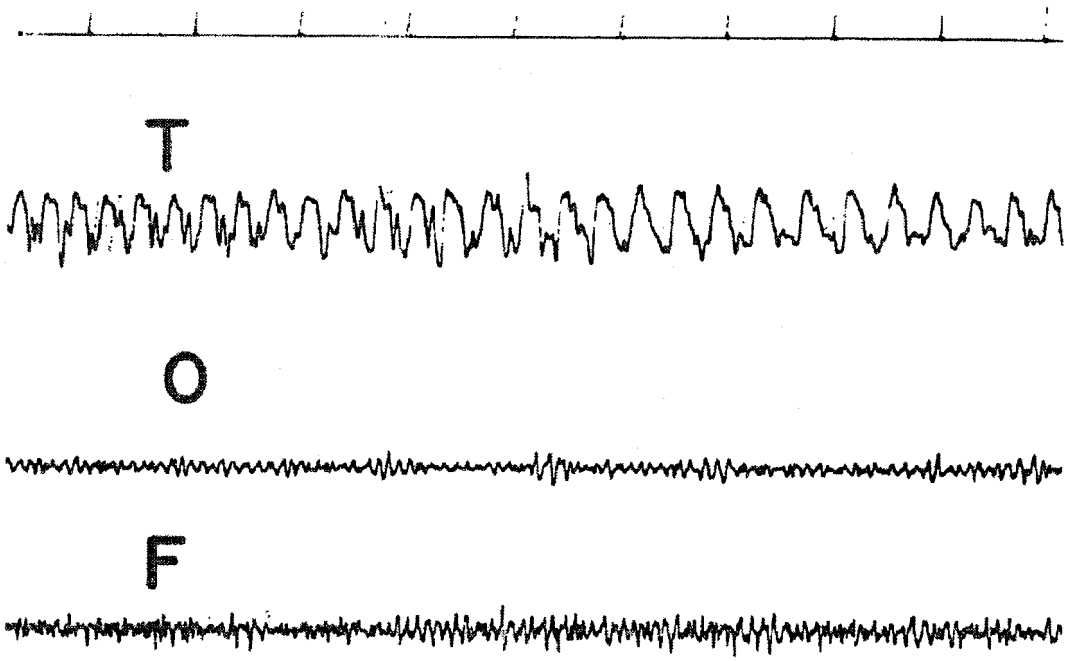


Figure 91. Occurrence of an electrical seizure over the temporal lobe during the experience of "God."

THE SEARCH FOR THE SELF LEADS TO THE SENSED PRESENCE

One of the last remaining challenges to modern neuroscience is to understand the neural bases to the sense of self. It appears to be associated with the linguistic processes often attributed to classical functions of the left hemisphere of the cerebrum. From a species perspective the propensity for people to fight and to die to maintain their culture and their language is not surprising. Without the language process there would probably not be the human sense of self.

During the late 1980s the Laurentian University Neuroscience Research Group was interested in the cerebral bases to creativity and insight. Many of the great thinkers of human history, from scientists to the initiators of spiritual traditions, had reported that their "insights" were associated with feeling of communion with some force that was greater than their own sense of self. The information that suddenly occurred during these insights was often beyond the knowledge of the person if only the content of his reinforcement history was considered.

Figure 92. Helmet for application of weak (10 nanoTesla to 1 microTesla), complex magnetic fields through the cerebral hemispheres.

To study this problem we developed a computer based technology for the application of weak (10 nanoTesla to 1 microTesla), complex magnetic fields through the cerebral hemispheres (Figure 92). The basic procedure involved subjects sitting in a quiet chamber while blind-folded. The rationale for this approach was to imitate the historical conditions in which many "inspirational insights" have been be experienced. Attenuation of the auditory and visual inputs would also allow the activity of neurons that are typically involved with passive surveillance of the environment to become recruited into the cerebral patterns associated with the applications of the experimental magnetic fields.

Most people reported a "sensed presence" of a Sentient Being. The interpretation of the "presence" was a function of: 1) the person's temporal lobe sensitivity that can be inferred by both electroencephalographic activity and self reports from questionnaire), 2) the available cultural attributions or beliefs for the experience, and, c) the shape of the magnetic fields. The experiences were emotional and personally significant. The reconstructions of these ephemeral experiences as a component of autobiographical memory are strongly influenced by the explanation the person attached to the experiences within a few seconds of their occurrence.

Our working hypothesis is that the sensed presence is the prototype of the God experience and is actually the transient awareness of the right hemispheric equivalent of the left hemispheric sense of self. Intrinsic complex electromagnetic patterns within the left hemisphere that generate the sense of self are experienced as "the other" when their right hemispheric equivalents intrude into awareness. Because of the reciprocal inhibition of activity between the two hemispheres, these periods of intense "intercalation" are infrequent for the normal brain, except perhaps during dreaming. However during periods of personal distress, psychological depression, certain psychotropic conditions, and meditation states these intrusions become more probable.

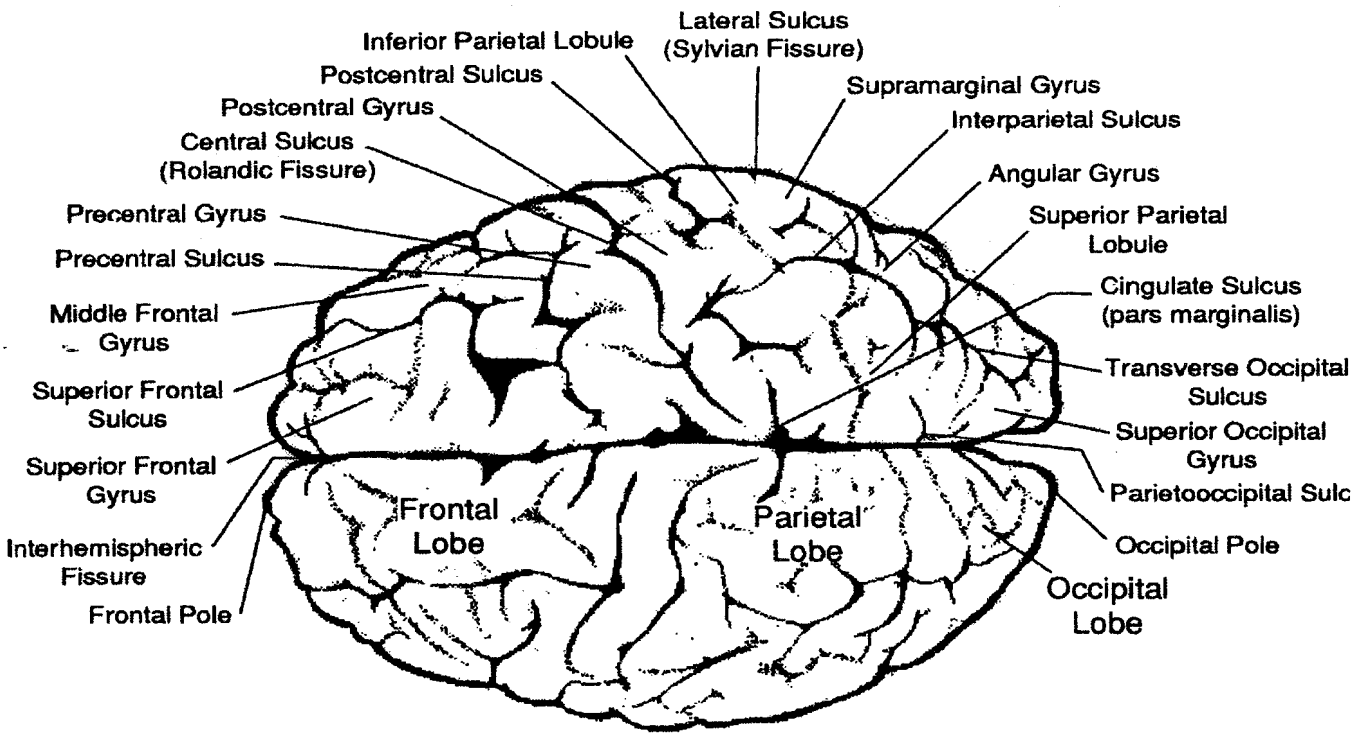


Figure 93. Diagram of a dorsal view of the right and left hemisphere. From Joseph, 1996.

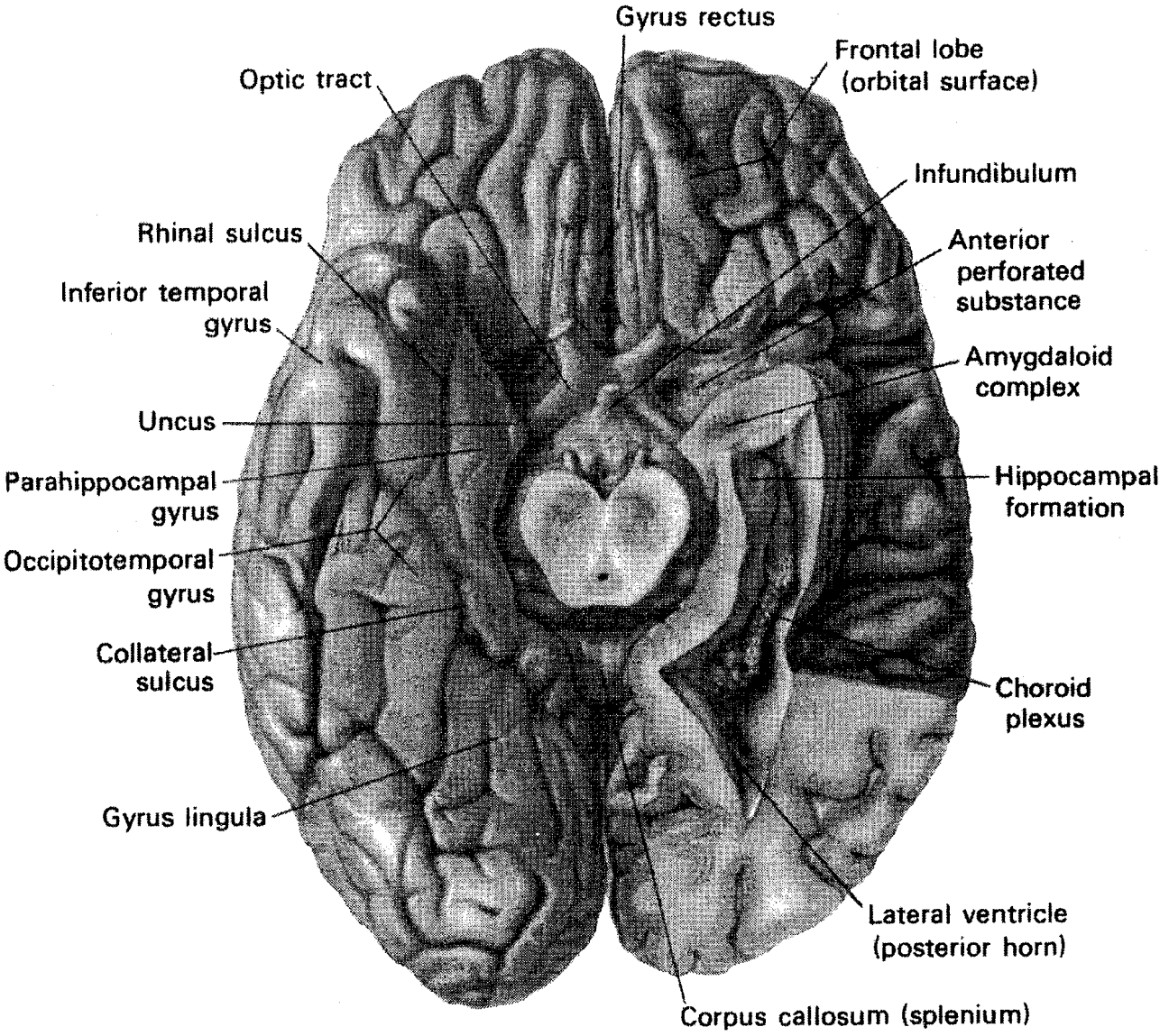


Figure 94. Ventral surface of the brain, partially dissected to show hippocampus and amygdala. From F. Mettler, 1948, Neuroanatomy. C. V. Mosby & Co. St. Louis

One would expect that the characteristics of the experiences would reflect the properties associated with the right hemisphere. For example the experiences would be profoundly emotional, spatial, "beyond the self", and meaningful. Our electroencephalographic measures in conjunction with the themes of these experiences indicated they involved the temporoparietal cortices and their limbic inputs from the amygdala (associated with cosmic meaning) and the hippocampus (the initial gateway to the cerebral representation of experience, i.e. complex memory). The most common correlates of the "sensed presence" include the experiences of "vibrations within the body", dream-like states, detachment of the self from the body, spinning, and either fear, aggression, or sexual arousal.

For example, a 21 year old woman with a history of diabetes who was exposed to a burst-firing magnetic field reported "I felt a presence behind me and then along the left side. When I tried to focus on its position the presence moved; every time I tried to sense where it was, it would move around. When it moved to the right side I experienced a deep sense of security like I had not experienced before. I started to cry when I felt is slowly fading away"

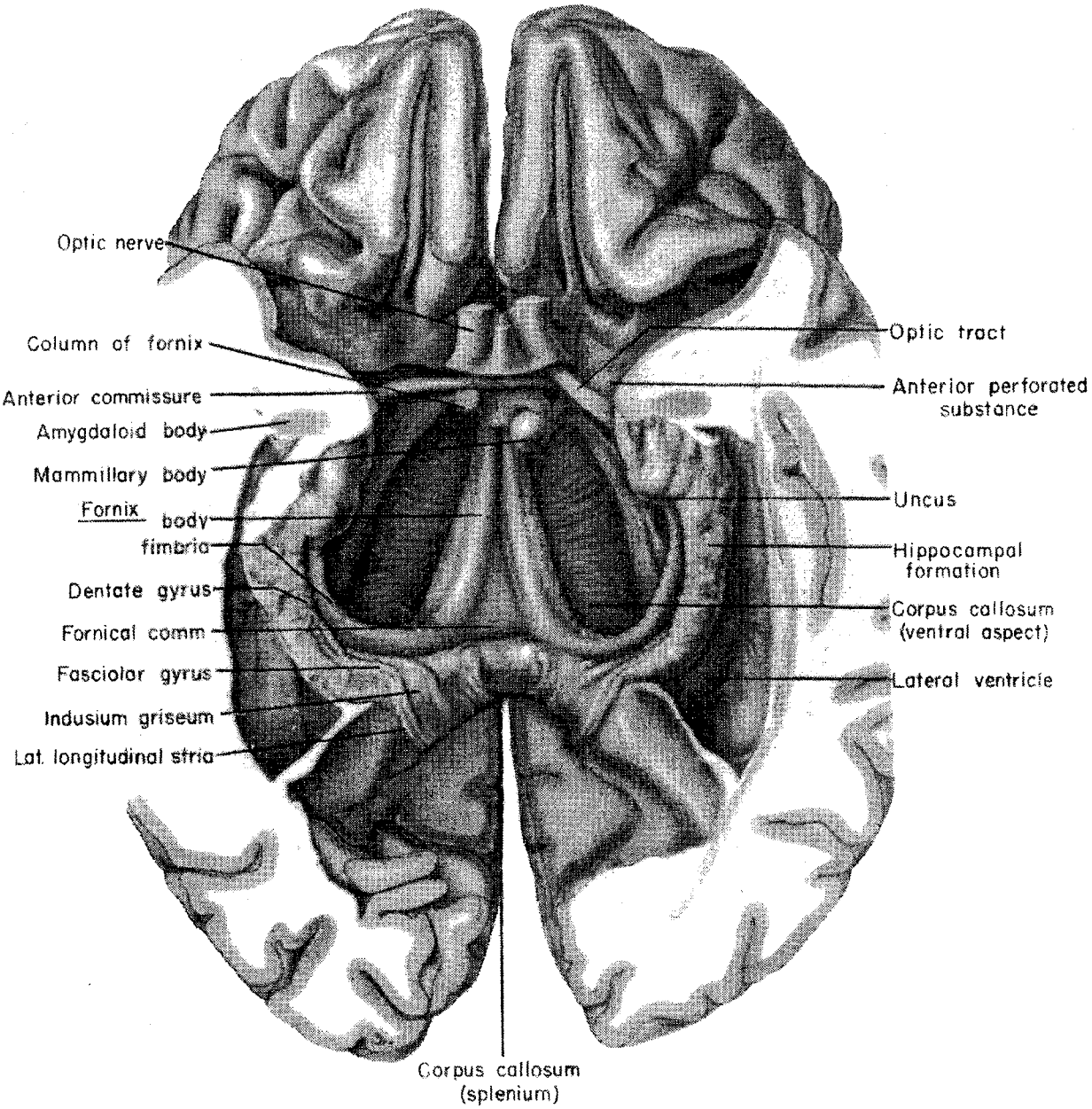


Figure 95. Dissection of the ventral surface of the brain. From F. Mettler, 1948, Neuroanatomy. C. V. Mosby & Co. St. Louis

(We had shifted the field parameters). From a physical perspective, one might expect that changes in the patterns of intracortical activity associated with the act of "focusing upon the position of the presence" would have been associated with an alteration in the neuroelectromagnetic patterns. Consequently the applied fields would have interacted with these mildly different patterns and hence the ongoing experiences and their attributions would have been modified as well.

Different patterns produce variations of the experience. For example a 30 year old woman who received a frequency-modulated field (3 msec durations for each point that generated the field) over the right temporoparietal region reported (as an ongoing narrative), " I feel detached from my body.. I am floating up.. there is a kind of vibration moving through my sternum.. there are odd lights or faces along my left side. My body is becoming very hot.. tingling sensations in my chest and stomach..now both arms. There's something feeling my ovaries. I can feel my left foot jerk. I feel there is someone in the room behind

me. The vibrations are very strong now and I can look down and see myself".

We have been impressed by the common neurophenomenological themes of the experiences reported by the hundreds of university students and special populations (including visiting journalists) we have tested during the last 15 years. Although in general older people, individuals who are artists, musicians, or writers, and women are more effective introspectionists, the themes associated with specific patterns of fields have remained consistent. Each experience however, has its own special signature that is likely to reflect the beliefs of the experient as well as the cultural labels.

For example, a 25 year old male who received the frequency-modulated pattern over both hemispheres with each point in the field being presented for only 1 msec reported (post session interview) "I felt as if there were a bright white light in front of me. I saw a black spot that became a kind of funnel..no tunnel that I felt drawn into..I felt moving, like spinning forward through it. I began to feel the presence of people, but I could not see them; they were along my sides. They were colourless, grey looking people. I know I was in the chamber but it was very real. I suddenly felt intense fear and felt ice cold."

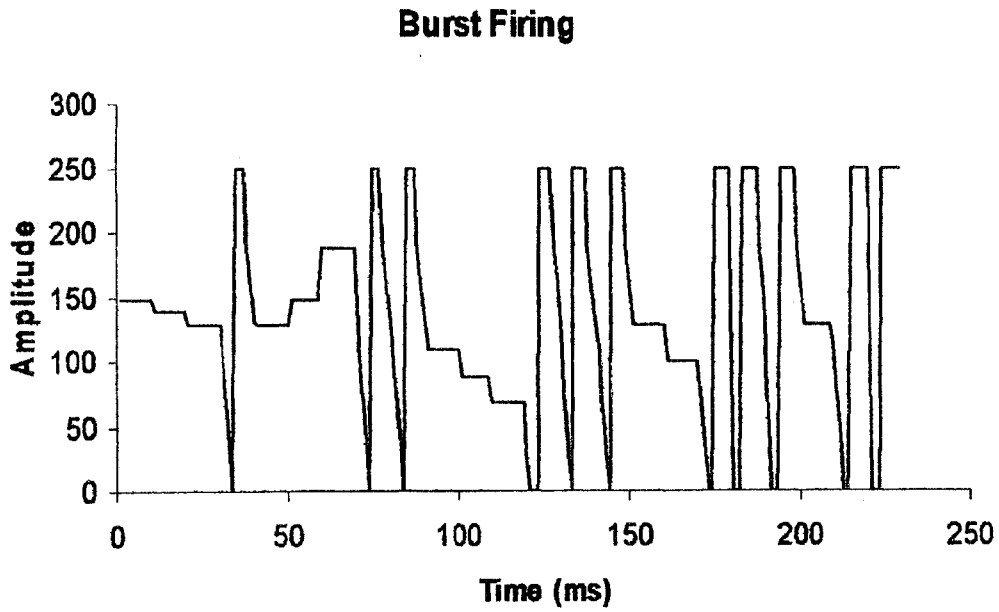
The application of the experimental complex, magnetic fields over the right hemisphere within the laboratory has consistently generated experiences of god or religious entities in people who believe in these experiences. For example a 50 year old man who reported he frequently feels Mother Mary or Christ during his daily life volunteered to participate. Without his knowledge for the timing of the presentations or the type of pattern, he reported (by button presses) the sudden "feeling" or the actual "visual presence" of Christ along his left side when a specific pattern was presented over his right temporoparietal region. The pattern imitated the pulse sequence known to produce long-term potentiation in hippocampal slices. Repeated presentations of this shape produced conspicuous but reversible reductions in the proportions of alpha rhythms measured over both occipital lobes and the right parietal region.

One of the questions that have been asked since we initiated this research is: What does an atheist experience within these contexts? We have exposed about 20 individuals, primarily experts in various disciplines who have visited the laboratory, who have identified themselves as atheists. They also report a sensed presence or detachment from their bodies (out of body experience) but attribute the phenomena to their own cognitive processes. Often the experiences are compared to specific states induced by psychotropic compounds the person has sampled. These results strongly suggest that the experience of a "sentient presence" is an intrinsic property of the human brain and of human experience.

THE EXPERIMENTAL PROCEDURE AND TECHNOLOGY

Unlike the tradition in biophysics to study the effects of magnetic stimulation by employing the simplest of shapes of fields, we reasoned that complexity and information within these fields were more important than their intensity. If one wanted to study the function of the arrangement of molecules upon biological systems the selection of two molecules of hydrogen and one of water, because "its simple," would not have permitted the discovery of the unique properties of proteins or nucleic acids.

The importance of weak intensities of complexity and asymmetry more than high intensities of simplicity and symmetry for providing significant information to large collections of neurons is analogous to the importance of complexity for sound. If the reader was studying and a 1000 Hz sine-wave sound occurred, then he or she would not respond unless the intensity began to exceed about 80 db when it would become irritating. However the complex mixtures of sound frequencies that produced the pattern "God is here" or "help



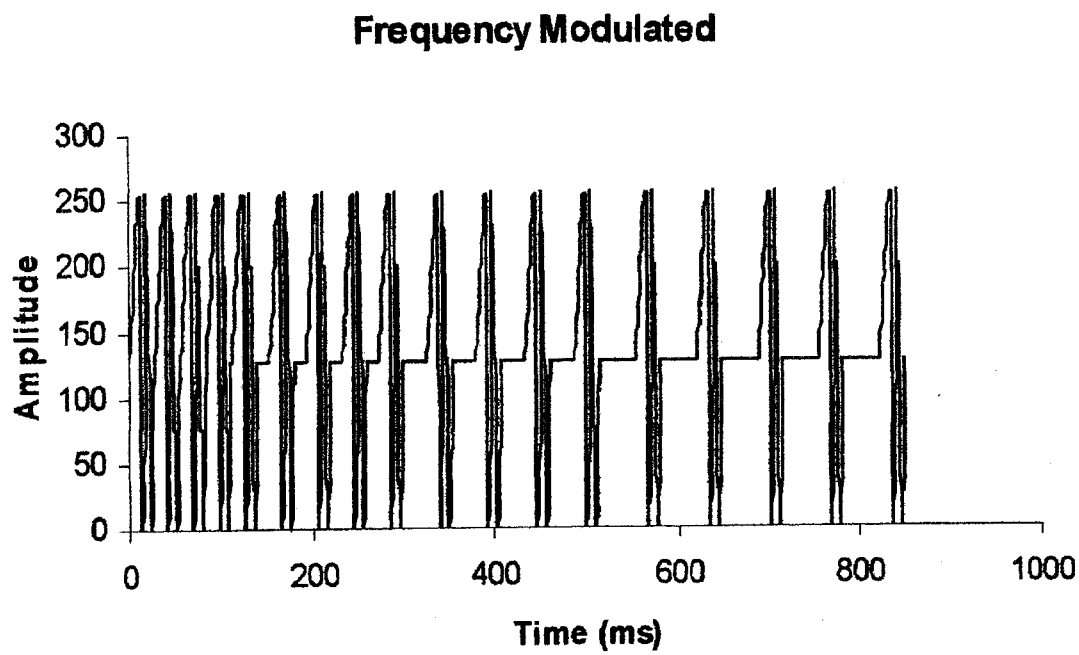


Figure 96. Two examples of complex patterns that, with appropriate parameters, have induced the Sensed Presence.

me", at only 20 db (just barely at threshold) contain information. These temporally asymmetric and complex patterns, depending upon the context in which they occurred and the explanation given by the experient, would have powerful behavioral consequences that could last a life time.

We decided that the temporal shapes of these fields would be most effective if their structures simulated the natural patterns generated by neurons and aggregates of neurons. To imitate natural patterns we extracted the activity of neurons, clusters of neurons, and even large arrays of electroencephalographic measurements. The specific complexities of these patterns were converted into columns of numbers with each number displaying a value between 0 and 255. The number 127 was "0" while numbers above or below this value represented positive or negative polarities, respectively. These numbers were then converted into voltages by digital-to-analogue converters and then delivered through solenoids, arranged around a person's head, to generate the magnetic fields.

The solenoids never touch the person's scalp to avoid any direct current induction or mechanical vibration. Instead the solenoids were embedded in a helmet, roughly at the level of the temporoparietal lobes for most individuals, within special containers that could be placed over more specific regions of the scalp, or in a type of "halo" device. In the latter geometry 8 solenoids are arranged equally in space around the scalp just above the ears. The electronic configuration of these devices allows the production of the complex magnetic fields to be generated through the brain from one hemisphere to another or to be rotated around the scalp.

There are four major parameters for these experimental magnetic fields. The first is the shape of the field itself. It is generated by the values in the column of numbers whose lengths range between 200 and 10,000 lines. The second parameter is the duration in real time of each number (and hence voltage) as it is read by the computer software. The brains of rats and humans appear to be most responsive to point-durations of between 1 msec and 3 msec. This means that if a pattern contains 1000 points and each point's duration is 3 msec, the duration of the electromagnetic pattern is 3000 msec or 3 sec.

The third parameter is the inter-stimulus time. This is the "no field" time between the presentations. We have explored interstimulus intervals between 3 msec and 10 sec in order to elicit the strongest effects. Obviously the intervals vary depending upon the type of experience. For example a burst-firing pattern, designed after the discharge pattern of amygdaloid neurons during an electrical seizure, pulsed once every 4 sec for about 20 min results in experiences equivalent to 4 mg/kg of morphine. Continuous presentation of this particular field does not produce this level of analgesia.

The fourth parameter is the total duration of the presentation of each pattern. Most of our studies have limited exposure to between 5 min and 40 min for convenience and to help develop strategies for potential applications to traditional clinical settings. Whereas repetition of the same pattern is more likely to evoke simple experiences within about 2 min, the sequential presentation of different patterns presented for about 2 to 5 min each appears to be sufficient to produce electroencephalographic entrainment and more experiences with varied themes.

We have employed three different procedures to measure the experiences associated with the application of the computer-generated weak magnetic fields. The first technique involves the recording of the ongoing narrative of experiences. Its advantage is the immediacy of the report and the direct access to the experient's own words that can later be analyzed for emotional meaning and text composition. However ongoing narratives sometimes interfere with the experiences.

The second technique has been to give the person an exit questionnaire after the experiment has been completed. The subject is required to rank the incidence of typical experiences reported within the setting. This technique does not require an ongoing narrative and, unlike the narrative procedure, does not interfere with the ongoing experiences. Its disadvantages are that many field-generated experiences are ephemeral and appear to dissipate within about 10 sec to 30 sec and the content of the post-experience questions could be incorporated into the reconstruction of the memory of the experience.

The third technique we have employed to study the "presence" is to instruct the subject to press one of two buttons to indicate when a presence occurred and on which side it was experienced. With this procedure the exact time of an experience can be recorded on the electroencephalographic record and the side of the experience can be determined without the disrupting consequences of talking into the lapel microphone. In addition this procedure allows the experimenter to expose the subject's brain to a large number of different patterns for brief periods in order to discern the latency of the responses. The disadvantage of this technique is the experimental expectation for the type of experience is set.

In all of our experiments neither the subject nor the experimenter, usually a graduate student or senior undergraduate (thesis) student, are aware of the expectations of the experiment. The subject is told that the experiment is concerned with relaxation and that weak magnetic fields may or may not be applied sometime during the experiment.

In Figure 97 (top), the relative intensity and frequency of the sensed presence compared to all other experiences during the experiment are shown for individuals who were exposed to either a sham field (equipment activated but no pattern generated from the computer) or to a burst-firing magnetic field applied asymmetrically over the left temporoparietal region, asymmetrically over the right temporoparietal region, or equally over both hemispheres (10 subjects per group). All subjects had engaged, just prior to the stimulation, in a procedure (Hypnosis Induction Profile) to enhance right hemispheric activity. The intensity of the sensed presence was greatest, compared to sham-field presentations, when this type of field was applied bilaterally.

Several experiments, involving about 100 subjects, showed that stimulation over the right hemisphere first by a continuous frequency modulated field for about 15 min followed by bilateral stimulation over the temporal-parietal lobes with a burst-firing field once every 3 or 4 sec, markedly facilitates the sensed presence. If the presence occurs during the right hemispheric stimulation, the experience appears to be along the left side and to be more emotional (or fearful). If the experience does not occur until the bilateral stimulation, the location of the "being" is perceived to be more to the right or on both sides and to be pleasant, even spiritual. About 80% of volunteers exposed to this sequence report a presence. The reverse procedure (burst-firing first followed by frequency-modulation) is less effective. Only about 10% of people exposed to sham-fields report a sensed presence. Most of them show above average numbers of temporal lobe experiences as defined by a pre-experimental questionnaire.

The elicitation of the sensed presence is specific to the temporal properties of the applied magnetic fields. The results of exposing the same subjects to a number of different patterns with different parameters and in different orders are shown in Figure 97 (bottom). The most effective configuration was the frequency-modulated pattern with point-durations of 3 msec. Reversed presentation of this number file that composed the FM pattern was not as effective. Even a very complex-sequenced magnetic field composed of 40 different shapes (within which the frequency modulated field was embedded), was not as effective.

EXPERIENCES OUTSIDE OF THE LABORATORY

Analyses of the common variance for clusters of subjective experiences reported by about 1,500 students measured over the last 15 years have shown that the sensed presence loaded on the same factor as the report of "being visited late at night by a cosmic consciousness" or "being at one with the universe". We have called this shared source of variance the "Muse" factor. Agreements with items such as "I feel intense meaning from reading poetry and prose", "I feel my thoughts are important to write down", "I have vestibular experiences such as low frequency waves undulating through the body as I fall asleep", and, "I have heard my name called just before 'falling asleep'".

In addition we have assessed, as a component of our practice in neuropsychology, more than 500 patients who have sustained mechanical trauma to their bodies. Most of these patients did not experience a suspension of consciousness and did not exhibit any CT-verified brain injury. More than 50% of these patients report that a sensed presence began to occur after the injury. In every instance the patient who reported the sensed presence felt as if he or she was no longer the same person.

The sensed presences were so disturbing that most of these patients had not reported the experiences to their physicians or to their loved ones because they were concerned about being labelled as "crazy". In general if the presence occurred primarily along the left side, the experience was considered negative. Apprehensions or sudden fears were frequent correlates. If the presence occurred primarily along the right side, the experience was considered either neutral or positive. "Internal" verbal messages, such as thoughts from the presence or "just knowing" information were more common.

The negative experiences were attributed in large part to ghosts or to cultural icons for "evil", such as demons, devils, or other adversaries. The positive experiences were attributed to deceased loved ones, such as a husband, a parent, or a god. They were considered "good". These experiences reduced the person's anxiety substantially.

We have also found that the sensed presence whose attributions range from bereavement apparitions to visitations from Gods or Aliens, occurs more frequently between midnight and 06 hr local time and in particular between 02 hr and 04 hr local time. This peak is the same period in which the greatest proportion of overt displays of temporal lobe seizures were recorded during the late nineteenth century before the implementation of effective medications.

Increases in global geomagnetic activity have been correlated with increases in both the numbers of "apparitions" and visual sensed presences as well as the numbers of epileptic seizures originating from limbic sources. That the brain is responding to the specific pattern and intensity (greater than about 40 nT) of the daily average global geomagnetic perturbations has been verified by the production of seizures in epileptic rats exposed to experimentally generated magnetic fields that precisely duplicated the temporal structure of geomagnetic fields.

One of the likely neurochemical mechanisms by which increases in geomagnetic activity encourages electrical lability within the limbic system is the suppression of the nocturnal levels of melatonin. This serotonin-derivative, primarily synthesized within the pineal organ, has dampening effects upon hippocampal electrical activity. Decreases in melatonin levels have been correlated with periods when daily geomagnetic activity increases above 20 nT and have been evoked by the nocturnal application of experimental magnetic fields with slightly larger strengths.

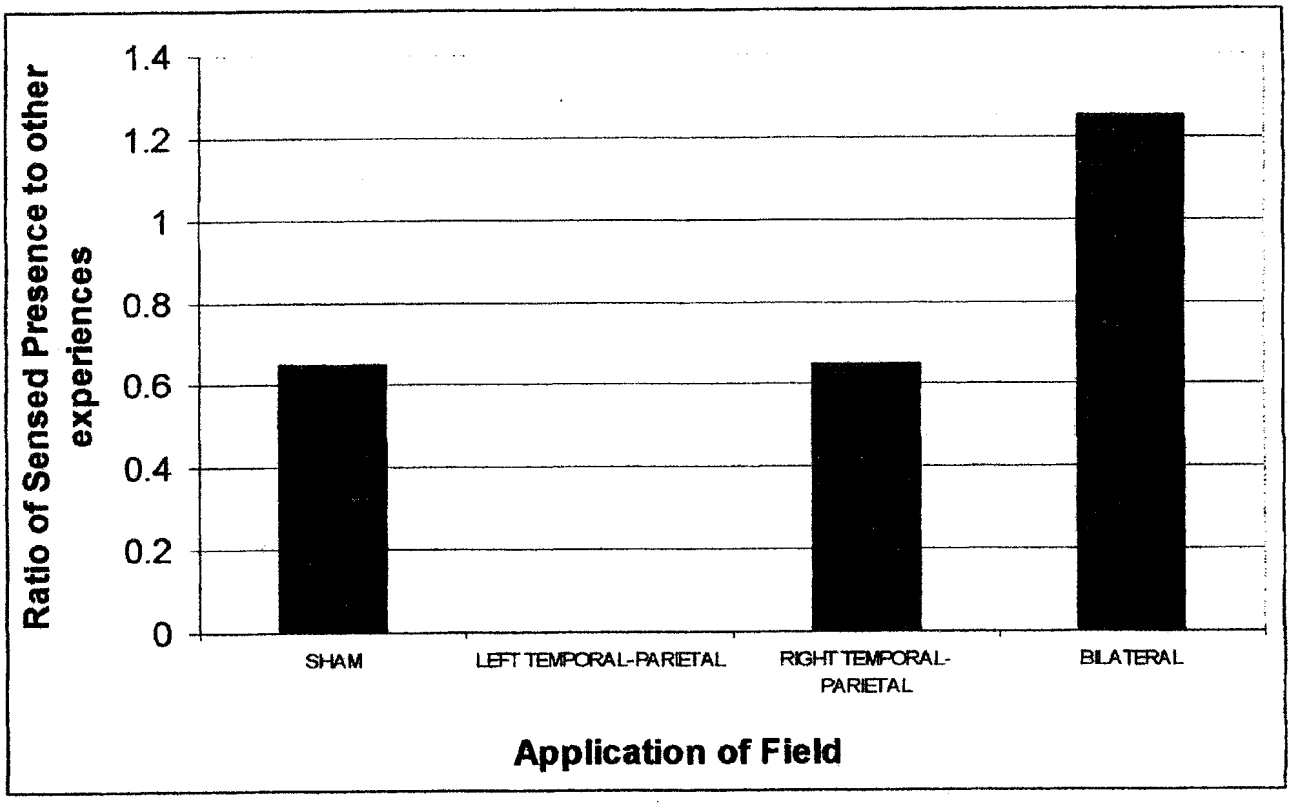
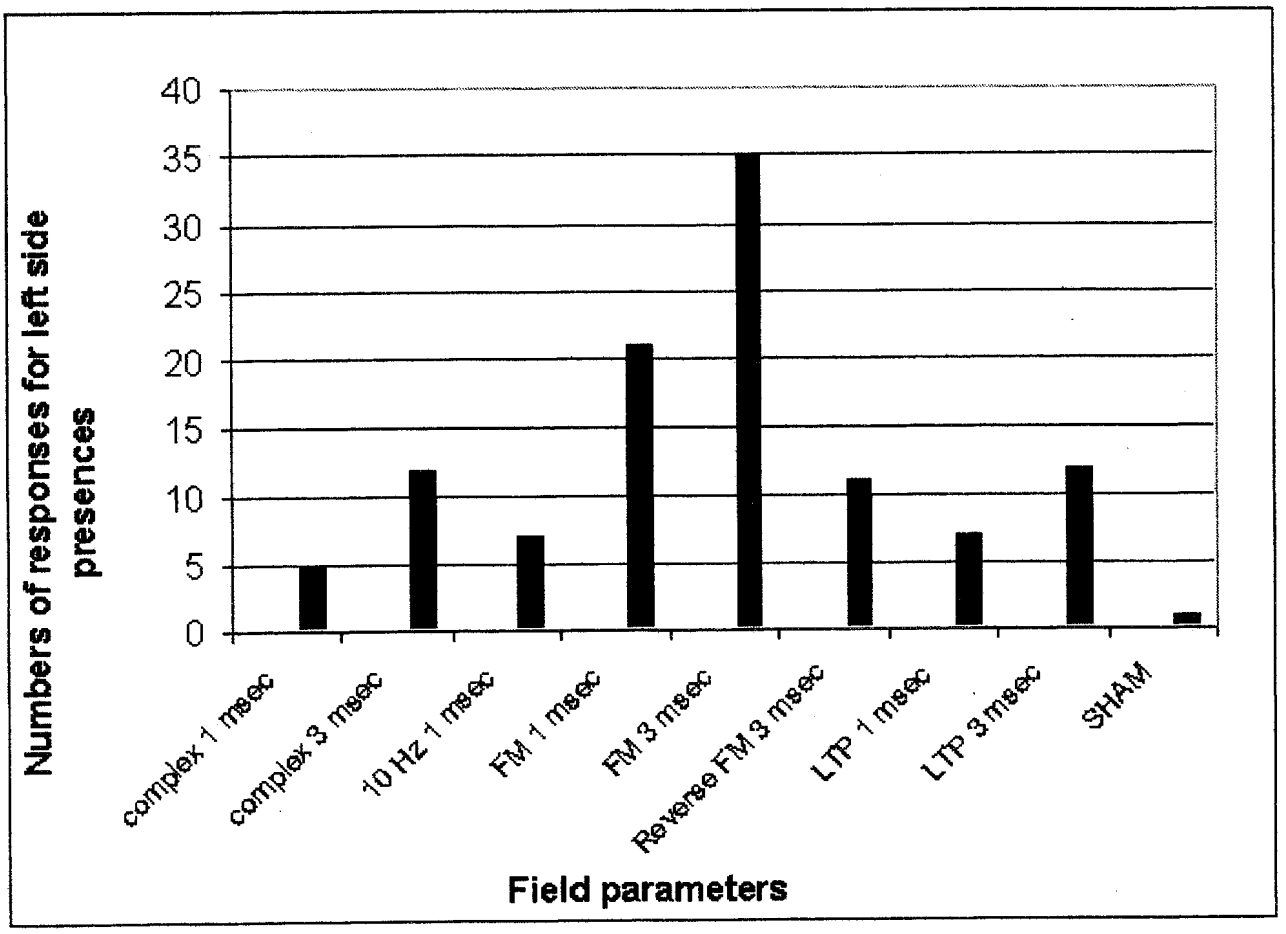


Figure 97. (Top) The ratio of the occurrence of sensed presences as compared to other experiences for subjects who received different configurations of the burst firing magnetic field or the sham field. (Bottom) Potency of different field patterns for producing sensed presences.



PERSONALITY CHANGES AND GOD EXPERIENCES

Some structures within the temporal lobe are well suited for initiating the changes in personality that follow the electrical transients associated with a god experience. Reactive synaptogenesis has been demonstrated in specific layers of the hippocampal formation in the brain of temporal lobe epileptics. Recently such reactive synaptogenesis, that contributes to electrical seizures within the limbic system, have been produced experimentally in rats.

Portions of the hippocampal formation are remarkably sensitive to brief periods of physical and chemical trauma. For example Sommer's section, or the CA1 region of the hippocampus, exhibits neuronal loss or reactive synaptogenesis following periods of hypoxia, maintained levels of the epileptogenic neuropeptides such as CRF (corticotrophin releasing factor), and insufficient blood supply. The unusual vasculature of portions of the hippocampal formation increases its vulnerability to marginal ischemic insufficiency. When one considers that the majority of the normal geriatric population exhibits electroencephalographic spikes or sharp transients focally over the temporal lobes, then one might appreciate the propensity for older individuals to report more religious experiences.

Sudden, unexpected, traumas to the brain can also initiate this sequence. Near-death experiences, that are often associated with marked insufficiency of either oxygen or glucose to portions of the limbic system, are followed by changes in the person's personality. Increased emphasis upon spirituality and even a decrease in thantophobia and existential anxiety are typical.

The changes in personality following intermittent neuroelectrical discharges within the structures of the temporal and limbic lobes have been described succinctly by Bear and Fedio for temporal lobe epileptic patients. More than 40 years ago Slater and Beard described a subpopulation of epileptic patients who maintained their cognitive capacity as well as their ability to interact with people. The patients reported intense religious experiences, often with vivid visual hallucinations, and profound beliefs.

Our measurements for both clinical patients who sustain brain traumas that affect functions of the temporal lobes and people who have experienced "temporal lobe transients", the mechanism we have proposed is associated with an intense god experience, strongly agree with the observations of other researchers. The immediate effects of a "god experience" involve intense dream-like experiences, prominent vestibular sensations ("lifting", feeling "free of burdens"), experiences of hearing-knowing information, and intense personal meaningfulness.

The after-effects of these experiences can be associated with confusion, disorientation, time loss, partial amnesia, and the incorporation of post-episodic information into the reconstruction of autobiographical memory. Typically a person whose is emotionally significant to the experient and to whom the experient has confided the experience will provide a label. The most common explanation is "you were called by god". The specific name, Yahweh, Allah, Jehovah, or the Great Cosmic Source, varies with the culture.

Ultimately personality changes emerge. There are bouts of automatic behavior and a sense of the personal. Events are perceived to occur because the person was "selected". A widening of affect encourages the person to infer patterns of meaning between unrelated experiences. Viscosity becomes more prominent and the person becomes fixed on specific ideas or phrases. In many individuals there is emphasis upon intuition rather than data or analytical deduction. An emergent focus upon nascent philosophical interests and the compulsion to record ones thoughts and feelings become more probable.

Finally, the person, because he or she feels "cosmic consent" is compelled to proselytize, to "spread the word". The person's social interactions are modified as he or she interacts

more frequently with people who share the same belief and aspirations. The person is described as " different" or "born again". Despite all of these changes the person exhibits normal social behavior without any loss in cognitive capacity.

HISTORICAL EXAMPLES

The histories of individuals around whom many religions have evolved strongly suggest marked enhancements of temporal lobe functions. The god experiences occurred in caves (Mohammed), during walks in the wilderness (Christ) or during imposed sensory deprivations (Buddha). Each of these human beings was convinced he had accessed the cosmic significance of the universe. Each of these experients of their own temporal lobe functions began religious movements that affected the development of human civilizations.

During the fifteenth century Guru Nanak, an unemployed musician, departed for his typical bath in a local river and disappeared for three days. When he returned, he remained silent for a day and then said "there is neither Hindu nor Muslim. I shall follow god's path". From his experiences the tradition of Sikhism emerged. Today a similar case might be attributed to an "abduction" experience by aliens.

During the nineteenth century a young son of a minister, while walking in the forest, felt a presence. He began to experience information from a persistent presence. He felt compelled to record these inspirations from the "messenger of god". The Church of the Latter Day Saints was born.

There is no doubt that the experiences of God have been associated with the most profound feelings of human existence. As stated through one of his characters Dostoyevsky stated "The air is filled with a big noise and I thought that it had engulfed me. I have really touched God. He came into me, myself; yes, God exists I cried and I don't remember anything else. All of you healthy people can't imagine the happiness we epileptics feel during the second before our attack. I don't know if this felicity lasts for seconds, hours, or months, but believe me, for all the joys that life brings, I would not exchange this one.

However these experiences are not always harmless. In a case reported by Spratling from the nineteenth century, before the era of modern medications, the (temporal lobe) epileptic patient reported "God told me that in my next life I would be born C.H.S. and marry my last sweetheart, and be a millionaire, and that I would be a strong, hopeful, and powerful Christian millionaire. I feel God's voice in my left ear at night. I feel the Lord in my chest. I see stars in my eyes. I have seen Christ crucified. God told me I would never have any more fits. God told me to bite off a patient's ear. If God told me to do wrong, it feels as if I would do it."

BELIEF IN GOD AS A 'COGNITIVE VIRUS'

Cultures have often been defined as groups of people with shared expectancies. Expectancies are beliefs by which we organize our experiential worlds. Beliefs are cognitive structures that allow us to predict the future and to minimize the anxiety of the unknown. To many cognitive processes the unknown is analogous to the anticipation of terror and unimaginable fear.

The sentence "I will die" is perhaps the most powerful three words that have maintained the god belief. It is the semantic equivalent of conditioned suppression or the conditioned emotional response. Human cultures have devised three strategies to diffuse this semantic time-bomb. It often explodes with the realization that the dissolution of the self: death, is irrevocably imminent.

The first strategy is to remove the anticipation of termination. Every culture has a

word or concept that refers to some component of the infinite, omnipresent and omniscient. If something is infinite, there is no end. If there is no end there is no anxiety.

The semantic operation to associate the person with this concept requires language structures that define the self as a subset of the infinite. Phrases such as "I am child of God" or "I will live on with God" are effective anxiolytics if one assumes implicitly that God is eternal. The "self" does not die because it becomes a component of the eternal.

The face validity of the illusion that the self is more than the body appears to be derived from the perpetual dichotomy between private and public behaviours. The resulting "dualism" between "the mind" and "the body" fosters the concept of souls, minds and other phlogiston-like entities that are reified by the experient. Once this assumption has emotional significance, even mundane experiences such as the perceptions in dreams where the self is separate from the body and in dimensions other than where the person is sleeping, become "proofs" that the "self" is independent of the finite physiology of the body.

One critical component of any god belief is that it must never be refutable or testable. Consequently the concept is always defined implicitly as "nonphysical", not measurable, and as the final default explanation when there are no apparent answers to questions. Faith, the religious variation of intense belief, is employed as proof of validity. The most typical retort to challenge is "prove god is not there".

The scientific method cannot prove a negative. However this semantic limit is not a weakness. It can be considered an encouragement to consider infinite possibilities as long as they are or could be measurable. The existence of god cannot be refuted because of the nature of the definition. It does not prove god exists. If I told you that the universe was controlled by invisible, nonphysical pink elephants would you believe? Prove they are not there.

The second approach to the problem of "I will die" has been to indict the validity of "I". Many eastern philosophies assume that the "I" is a social fiction. It is only created by the language and expectations of the culture. Consequently the "true path" is found by minimizing the role of language and by focusing upon the essence that remains. The self is simply a component of the large Cosmic Whole. There is no end to the whole.

The third approach is to this problem is to remove the "will" and replace it with the present tense. This solution, more popular among atheists and existentialists, can minimize anxiety because the anticipatory component is markedly attenuated. An aversive stimulus being experienced has much less anxiety than one being anticipated.

From a Darwinian perspective, one might appreciate the maintenance of the temporal lobe experiences that promote the God belief. If there had not been survival value associated with both the experience and the belief of gods, these behaviours should have been selected against long ago. They should have been deleted from our genetic expression.

One speculation is that during the early stages of the development of the self, the powerful capacity to anticipate the future was also associated with the capacity to anticipate one's own demise. If some other process had not emerged to attenuate this anxiety, the fragile sense of human self would have been fragmented. The incapacitation of anxiety and existential terror would have dominated.

Today most people acquire one of these solutions to the issue of personal death during their childhood. These explanations are given by parents or caregivers during the necessary times when pets, grandparents or friends die. By inference, which even the infant brain can display, the anticipation of the self's own demise emerges.

As the microstructure of the brain matures and the child progresses through the cognitive stages of development, this belief is present to minimize the anxiety. As maturation proceeds,

the belief there is a god with whom the sense of self can never end remains embedded within each cognitive stage. By the time the organism achieves adulthood, with the faculties to question the validity and the utility of the god belief, it has become an intricate part of the cognitive structure defining the self. To challenge it or even to examine it could begin the unravelling of the person's sense of self.

Our experimental work to explore why people avoid the question of the validity of the god belief indicates that the belief has many of the characteristics of a delusion. As many clinicians will acknowledge, directing the verbal behavior of delusional patients towards the logical conclusion that their beliefs are unreasonable or false is very difficult. Within one or two logical steps from the conclusion that the delusion is false, the patient's cognitive process often stops or is diverted to some other topic.

To examine how people avoid the logical conclusion that a belief is not valid, we have been asking volunteers to respond as quickly as possible to a series of progressive statements presented for 5 sec each on a computer. The person must respond yes or no as quickly as possible. The items begin with the statement that the universe is composed of matter and energy and then gradually move towards the evolution of molecules and cells.

For demonstration, beginning with item 17, "The neuron is cell", the statements slowly shift towards the conclusion that would indict the validity of the god belief. The questions are: 18, "The brain is composed of neurons", 20 "Different interactions produce different behaviors", 21 "All perceptions occur within the brain", 22 "All experiences occur within the brain", 23 "Beliefs are composed of experiences". 24 "Most people believe in the existence of God", 25 "God if a belief", 26 "God is an experience within the brain", 27 "All experiences are produced by the brain", 28 "The experience of God is produced by the brain", 29 "God does not exist except within the brain".

We have noted that as volunteers (particularly the ones who belief in god and attend church frequently) begin to approach statement 29, beginning around statement 24, their response times slowly increase even after the grammar and length of the statements have been accommodated. If processes associated with the right hemisphere (such as the accuracy for words presented to the left ear during dichotic word processing) are monitored there is an increase in this activity during the items (26,27) that precede the conclusion that god is simply generated within the brain.

These data indicate there are experimental procedures that might help elucidate the neuromechanisms by which the average person avoids or ignores the logical conclusion that their belief in god may not be valid. The approach also suggests that every time the god belief is evoked to minimize anxiety, the strength of the belief, like any operant response, is strengthened. Effectively the belief becomes a powerful cognitive anxiolytic and antidepressant for the challenges to the left hemispheric sense of self.

However there may be a negative component to this intellectual opiate. Suppose another group of people exists who embrace a different god? If another god exists then does your god loose its omnipotent power? What happens when the experiences attributed to this god indicate that he or she is the only one god and believers in any other deity are less than human and hence expendable? Suppose your personal immortality is threatened. Would you kill to preserve your immortality?

"I WOULD KILL IN GOD'S NAME"

Specific electrical anomalies within the limbic system, particularly the amygdala, can trigger aggression and killing. Any stimulus that changes the threshold for amygdaloid-hypothalamic activity, from specific smells to suppression of nocturnal melatonin by

geomagnetic activity, can evoke the response.

The human species is one of the most aggressive species that has existed. We are the Tyrannosaurus Rex of the mammals. As a species we have killed every animal form we have encountered, sometimes to extinction. As a species, our first response to discovery, from gunpowder to atomic fission, has been to kill the perceived enemy. We even kill each other. Since the year 1500, approximately 150 million human beings have died during armed conflicts between nations.

More cultures have been raped and razed in the names of Jehovah, Allah, or the Great Cosmic Guide than one can imagine. Although sociologists and historians often attribute these episodes to political or economic causes, the individuals who engaged in killing often reported they felt as if they had "god's consent." When personal immortality of the self is involved, fear of being killed in battle is trivial by comparison.

Although not every one might kill others if they believed that their god had condoned it, the proportion of individuals who report they would is disturbingly high. About 7% of first year university students enrolled in psychology classes reported "yes" to the statement "If God told me to kill I would in His Name." Post-inventory interviews indicated these responders were not randomly responding or engaging in frivolous activity.

Whereas 10% of the population who said they would kill in God's name were males, only 5% were females. Twenty-five (25%) of the males who frequently attended a church, synagogue, mosque, or other religious context reported they would kill while only 9% of women who attended church frequently agreed with this item. For those males who attended church frequently, who reported they had a religious experience, and who displayed elevated temporal lobes signs, about 50% stated they would kill in God's name.

Close scrutiny of the personality profiles and psychological tests for these individuals indicated they were not pathological. The scores for the scales from the Minnesota Multiphasic Personality Inventory (MMPI), whose items are derived from psychiatric concepts of behavior, were within the average range or certainly not significantly different from people who reported they would not kill. The individuals who reported they would kill also did not differ with respect to suggestibility, proneness to imaginings, or self esteem. From a psychiatric and psychopathological perspective, these people were normal.

Most religious texts, including the Bible, the Koran, the Egyptian Book of the Dead, and the Book of Mormon, have frequent references to killing of others as proofs of gods' powers or justifications for their existence. People who do not belong to the same belief system are marginalized as unenlightened and become candidates for extinction. Nomad groups, believing themselves to the "chosen", have marched into lands belonging to others and have slaughtered entire peoples because "god gave us the land."

To study how normal individuals might endorse ideas of killing others in the name of a god, we have selected passages from the major religious texts concerning those topics. To mask the sources and the historical syntax of these scriptures, the phrases are paraphrased and the name of the god has been replaced with "Alien." For example, one passage read "If you should die or be killed in the cause of the Alien, the Alien's forgiveness and mercy would be surely better than all of the riches. If you die or be killed you will be taken by the Alien into his midst." Another passage read "Those who rebel against the alien listen to the evil forces. They become an enemy of the Alien and all that is right. Therefore, the Alien has no place for them in his domain. If you die before you believe in the Alien you will become conscious of your own guilt. It will fill your Being with pain, anguish, and an unquenchable fire whose flame will last forever.

These items were given to university students under the title of "Clinical Rating

Exercise". The student evaluators were asked "Read the following comments of delusional patients about their reports of receiving special information during alien abductions. The specific name of the alien has been changed simply to alien. Your task is to determine which of these patients are most dangerous to society because of their beliefs about their mortality or definition of self with respect to dissolution of the self, i.e., death. Your job is to protect society from dangerous offenders." The evaluators were then asked to rate each comment from each "patient" (actually a scriptural source) on a Likert scale between 1 (not dangerous) and 7 (extremely dangerous).

The most conspicuous result from these studies is that university students who endorse extreme religious beliefs consider items about killing, such as the first example noted above, not to be dangerous to society. This association was evident regardless of the person's professed religious affiliation. These individuals also felt there was forbidden knowledge. They answered "yes" to items such as "There are things Science should not investigate" and "Belief in science and religion are not compatible".

It is interesting when these same items are quoted in the original and are referenced to the source, the ratings of the dangerousness is less (within the range of neutral). Whether this response bias reflects the political correctness of the contemporary culture concerning other's religion or some implicit assumption that religion can only be positive, remains to be investigated.

IMPLICATIONS

Our research, as well as the results of other experimenters, indicates that the experiences and beliefs about gods are normal properties of the human brain. In all probability they have developed within our species with other cognitive functions in order to facilitate adaptability. The primary role of the beliefs may have been to reduce anxiety about self-dissolution that, if not controlled, could have interfered with adaptation.

There is now experimental evidence that the experience of god can be simulated with the laboratory. Although we have shown general patterns of electromagnetic fields that can induce these experiences, it is likely that different people will require variations of parameters in order to optimize the experience. This technical variation would be analogous to the selection of the specific antidepressant and appropriate dosages for different patients.

Because the same brain structures and patterns that evoke the god experience are also associated with sexual behavior and aggression, god experiences and beliefs could encourage aggression towards individuals who do not share these beliefs if the person experiences an "instruction" attributed to god. We are social animals that require social proximity and affiliation with groups. A component of this cohesion is the exclusion of others who do not belong, particularly when the validity of the belief that defines the group is threatened.

There are many stimuli, perhaps some yet to be discovered, that can evoke the experiences of God and foster religious beliefs. If the history of science predicts the future as it has explained the past, future discoveries will likely reveal phenomena that are even greater than the God experience and the God belief. Like the phlogiston of preconceptual chemistry or the concept of "epicycles" for Ptolemy's explanation for the motions of planets, the current explanations for the experiences of the Sentient Being as a Creator and assurance for personal immortality will no longer be required. Such changes are the nature of scientific discovery.

However there is now a potential technology that could be developed to enhance the experiences of "Sentient Beings" within large populations without their awareness. The patterns we have explored, extracted from natural stimuli, can be generated over significant

distances. Like all technologies it can be employed for everyone or for the benefit of a few. This technology controls the prototypical experience for the belief of immortality. Understanding the neuroscience of god experiences and beliefs and how it can be provoked or prevented may be critical to the survival of our species.

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